Impact of Biophilic Interior Design on Cognitive Performance and Emotional Health in Work Environments

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Abstract

The study investigates the effects of bio-philic interior design on cognitive functioning and affective wellbeing in occupational settings based on a secondary data methodology. Due to the rapid urbanization and increased indoor time, the loss of connection to nature has been associated with stress, decreased productivity, and decreased well-being. The study is a synthesis of 30 to 50 peer-reviewed articles, reports, and case studies that assess the effect of the combination of natural elements, including indoor vegetation, natural illumination, ventilation, and nature-related materials on employee performance. The results show that biophilic design has considerable benefits in improving attention, memory, creativity, and overall cognitive efficiency and decreasing the levels of stress, fatigue, anxiety, and depression. The paper also provides the participation of theories like Attention Restoration Theory (ART) and Stress Restoration Theory (SRT) in aiding to understand such advantages. Moreover, the biophilic factors that warrant employee satisfaction, engagement, and productivity are identified in varied working environments. All in all, the study promotes the use of biophilic design as an effective and sustainable approach to enhancing mental health and performance at the workplace.

Keywords:
Biophilic design; Cognitive performance; Emotional health; Workplace productivity; Indoor environment quality; Employee well-being; Attention restoration; Stress reduction

How to cite this article: Kamble VD, Patil PS, Nanaware T. Impact of Biophilic Interior Design on Cognitive Performance and Emotional Health in Work Environments. Int J Drug Deliv Technol. 2026;16(70s): 211-218. DOI: 10.25258/ijddt.16.70s.22

1. Introduction

Indoor environmental quality (IEQ) significantly influences productivity, health, and well-being. The consequences may be most apparent in workplaces, where full-time employees dedicate around one-third of their day, five days per week. Research from public health and building sciences has shown that environmental factors, such as indoor air quality, ventilation, thermal comfort, water quality, moisture, safety and security, lighting and views, noise, dust, and pests, are essential to human health [1]. In addition to examining indoor exposures that result in negative health outcomes, researchers have also addressed, although less often, the potential of optimising indoor environments and building design to enhance cognitive function, productivity, health, and well-being [2].

The incorporation of natural elements inside, known as biophilic design, has garnered heightened interest lately owing to its prospective health advantages. The term originates from biophilia, meaning "love of life and living systems," popularised by Edward O. Wilson in 1984. In 1993, He and Stephen R. Kellert presented the biophilic hypothesis, asserting that humans' intrinsic connection to nature is vital for their well-being. Currently, our access to natural areas is diminishing due to increased urbanisation, with individuals mostly spending their time inside. Biophilic design aims to strengthen the individual's connection to nature by integrating natural elements into constructed settings where we live and work [3]. Initiatives to implement biophilic design involve identifying design characteristics and classifying them into three domains (i.e., nature within spaces, natural analogues, and the essence of the space) and

14 patterns, emphasising the most significant nature-health connections in the built environment [4].

Natural light is beneficial for circadian rhythm and sleep quality, and it may also enhance feelings of vigour, activity patterns, and overall quality of life. Alongside indoor plants and natural light, materials and patterns that emulate nature, referred to as "natural analogues," are fundamental to biophilic design. Nevertheless, little research exists about their health advantages, with the majority concentrating on hardwood materials. The use of interior hardwood materials has been shown to diminish autonomic stress reactions, tension, and exhaustion, while enhancing pleasant feelings and comfort [5]. Alongside virtual exposure, haptic exposure, such as tactile interaction with wood, has been shown to induce physiological calm. Ultimately, natural shapes and structures in architecture are considered beneficial for human emotional and cognitive functioning; yet, less scientific proof has been shown [6].

Figure 1. The Positive Impact of Biophilic Design on Mental Health and Cognitive Function

Source:
https://media.licdn.com/dms/image/v2/D5612AQHk7of4HWlDIA/article-cover_image-shrink_600_2000/article-cover_image-shrink_600_2000/0/1721177483191?e=2147483647&v=beta&t=ABYcGk3GvQhlhtJCrCyHn7bFXhx5lml4wpMj8if8PaA

Emerging technologies has the capacity to overcome some constraints of prior research. Virtual reality (VR) enables systematic alterations of interior environments that cannot be efficiently executed in the physical world. It may provide more immersive experiences of various natural situations than video, photography, and sketching in controlled laboratory settings. Numerous research have shown that exposure to virtual surroundings in virtual reality may provide effects comparable to those seen in actual situations [7]. The virtual representation of natural ecosystems across several contexts (e.g., forests, urban green spaces, streetscapes, biophilic interior spaces) has been used to assess their impact on stress reduction, attention restoration, and cognitive performance. Eye-tracking, in conjunction with virtual reality, offers a unique chance to quantify individuals' visual attention to certain items inside a simulated virtual world by assessing the duration of concentration on specific objects [8]. Wearable biomonitoring sensors, integrated with a virtual reality experience, assess a participant's physiological reactions, including heart rate variability and skin conductance level, during the experiment.

They developed a Biophilic Interventions in Office (BIO) study that integrates VR, eye-tracking, and wearable biomonitoring sensors to analyse participants' reactions to various biophilic designs (i.e., natural elements, natural analogues, and their combination) in two workspace environments (i.e., open space versus enclosed space). Alongside physiological studies of stress response, we included cognitive evaluations of creativity and attentiveness.

2. Review of Existing Studies on Biophilic Design in Work Environments

Youn et al., (2025) investigated the potential restorative advantages of using biophilic spatial design in hospital settings for nurses operating in high-stress conditions. The findings indicated that exposure to the biophilic environment markedly decreased oxyhemoglobin (oxy-Hb) levels in the dorsolateral prefrontal cortex (DLPFC), signifying alleviation of cognitive-emotional strain and improved neural stability. Psychological assessments revealed reductions in weariness, melancholy, and anxiety, as well as enhancements in vigour, attention, and felt restorativeness under biophilic environments. The results indicate that even short exposure to a biophilically designed interior environment may provide cognitive restorative benefits, implying that biophilic interventions are durable and successful ways for promoting healthier workplaces and urban settings [9].

Gerges et al., (2025) explored the beneficial impact of biophilic design on cognitive performance in workplace settings in Egypt, including co-working spaces. This study will elucidate the primary challenges confronting stakeholders in conventional work settings, emphasising the significance of co-working spaces as an emerging trend, supported by an analysis of several case studies in Egypt. The research will emphasise the influence of biophilic design on cognitive performance in co-working environments [10].

Mengqi et al., (2025) analyzed the effects of three design types—nonbiophilic, curved, and biomimetic—on stress levels and cognitive functioning of Chinese high school students in school hallways and classrooms. Our findings demonstrated that indirect exposure to nature, especially in curved shapes, promotes superior

cognitive enhancement and stress alleviation, whereas nonbiophilic forms provide increased stress protection advantages. Consequently, educational settings lacking biophilic design may be more appropriate for stress-inducing activities, such as lectures and assessments. Learning settings with curved biophilic designs may be more effective in fostering relaxation, creativity, and focus [11].

Crizel et al., (2025) examined studies that focus on the incorporation of natural elements, including flora, water features, natural lighting, as well as materials, textures, and organic shapes in architectural and interior design projects. It further investigates the use of data gathered by biosensors to evaluate the effects of these designs on the physiological and psychological conditions of persons. This empirical technique seeks to provide evidence that substantiates the efficacy of biophilic design in improving mood, alleviating stress, and augmenting productivity and creativity. The exhibited works aim to integrate nature with the built environment, enhancing the design of daily areas to promote harmony and improve human health and well-being. The primary objective is to position biophilic design not only as a fad, but as an essential component of human-centered architecture and interior design [12].

Alipour et al., (2024) suggested the significance of the human-nature link in workplace design, examining the impact of direct and indirect biophilic indicators on employee well-being and performance inside a business. The findings demonstrated that biophilic elements had a substantial positive correlation with employee well-being; however, no significant correlation was identified between biophilic elements and employee performance. The ANOVA test identified biophilic markers that positively and significantly influence employee well-being and performance. The beautiful scenery and warm colours significantly enhance social well-being, and the use of natural landscape posters at workspaces has a favourable and substantial correlation with psychological well-being. This research involves the construction and validation of an instrument to assess the impact of biophilic indicators on employee well-being and performance parameters [13].

Fukumoto et al., (2024) assessed the impact of various biophilic designs in workplace environments on the psychological and physiological reactions, as well as the cognitive performance of office employees. This research used indoor greening rooms including Japanese and tropical styles, alongside a green-free (control) design. Nonetheless, there was an improvement in perceptions about tropical and Japanese styles in working spaces. The Japanese design proved more helpful in reducing negative feelings than the tropical style. The electroencephalography conducted during a 5-minute exposure to the green designs revealed restricted frequency bands and specific regions of interest influenced by the greenery design. In conjunction with the psychological data, indoor greening using a tropical design fostered favourable mood states. Simultaneously, indoor greenery in Japanese design mitigated adverse emotional states. Nevertheless, no substantial changes were seen between the two designs for cognitive task performance. Consequently, indoor vegetation enhances brain efficiency during cognitive activities [14].

Shen et al., (2020) observed the influence of wooden elements on the preferences and cognitive performance of 20 persons (10 females and 10 males). Participants exhibited superior performance on neurobehavioral assessments in the wooden setting compared to the non-wooden environment. The average completion durations of participants fell by 16 seconds, 5 seconds, 6 seconds, 16 seconds, and 7 seconds, respectively, for the Visual Reaction, Continuous Operation, Stroop, Calculation, and Meaningless Picture Recognition tasks in timber vs concrete surroundings. In all five assessments, participants provided a greater number of accurate responses in the three hardwood environments compared to the concrete setting. The findings corroborate the biophilic theory, indicating that the integration of woody materials in interior design may enhance occupant contentment and cognitive function [15].

3. Objective

- To evaluate the impact of biophilic design on cognitive performance using secondary data.
- To assess the effects of biophilic design on emotional health outcomes from existing studies.
- To identify key biophilic elements influencing employee satisfaction and engagement.

4. Research Methodology

4.1 Research Design

The research design is a descriptive and analytical research design that relies on secondary data in an attempt to determine the effects of biophilic interior design on cognitive performance and emotional wellbeing in workplaces. It derives the findings of peer-reviewed journals, reports, and case study to determine the relationship between biophilic factors and employee outcomes. The comparative approach is applied to analyze the differences of various work environments. The design allows interpreting the available evidence in a systematic manner and can be used to determine the patterns, trends, and gaps in the research concerning the topic of employee satisfaction and engagement.

4.2 Data Collection

The information is gathered using only the secondary sources, such as academic journals, conference papers, organizational reports, and reputable online databases like Google Scholar, PubMed, and Scopus. The keywords that will be used include biophilic design, cognitive performance, emotional health, and productivity at work. Only new and appropriate studies are chosen to implement reliability and validity. The data gathered revolves around documented effects of biophilic interventions, such as natural lighting, indoor plants, and ventilation, to add towards a holistic view of the effects.

4.3 Data Analysis Tools

In analyzing the data collected, the study uses qualitative content analysis and comparative analysis methods. Major themes connected with the cognitive performance, emotional state, and engagement of employees are identified and divided. Findings of various studies are summarised using tables and charts to make them easier to understand. Moreover, trend analysis is done to monitor the repetitive patterns of the effectiveness of certain biophilic elements. These are used to assess the relationship in a systemic manner and to make meaningful conclusions based on various sources of secondary data.

4.4 Ethical Considerations

Since the study is founded on secondary data, it will sufficiently cite and give credit to all original sources to uphold academic integrity. No personal and confidential information is ever employed, and ethical risks are reduced. The paper is free of plagiarism as it uses paraphrasing and the reference of sources as per the standard citation styles. Also, only peer-reviewed and credible sources are added to make it authentic and reliable. Data usage and ethical issues regarding use of intellectual property are observed to the book during the research process.

5. Result and Analysis

Objective 1. To evaluate the impact of biophilic design on cognitive performance using secondary data.

In the era of global urbanization, access to the natural environment is diminishing, and individuals mostly spend their days inside. Reduced access to nature correlates with heightened physical and mental health problems, as well as stress-related illnesses. Simultaneously, access to and engagement with the natural environment may enhance both physical and mental well-being [16]. Wilson posited the biophilia theory, asserting that people are predisposed to develop fondness for and instinctively pursue links with natural species and systems. Designing vegetation according to this theory is termed biophilic design and is garnering interest as a strategy for enhancing interior spaces (e.g., hotel lobbies) [17]. Indoor biophilic greening has physiological and psychological consequences. It reduces heart rate, blood pressure, weariness, and mental stress.

Enhancements in emotional and cognitive functions resulting from interaction with nature were also noted. Numerous studies have shown that exposure to nature influences attention and memory. This concept is grounded on two theoretical frameworks of environmental psychology: attention restoration theory (ART) and stress restoration theory (SRT) [18]. Attention Restoration Theory posits that exposure to nature helps rejuvenate attentional resources, whereas urban environments lead to cognitive weariness owing to the exhaustion of the directed attention mechanism. SRT suggests that interaction with the natural world enhances good emotions and aids in recuperation from physiological stress. Consequently, reduced stress levels enhance performance on cognitive and attentional tasks.

Neural activity, specifically brain activity, should be analyzed before to and after natural encounters to ascertain potential causative pathways for the benefits found in biophilic investigations [19]. An effective biophilic design incorporates several views, including the adjacent natural environment, societal norms and traditions, and the building's functionality [20]. It cultivates inspirational, restorative, healthful, and cohesive environments that align with the functioning of the location and the urban ecology it pertains to. This research examined the designs used in biophilic greening for workplace environments. Integrating biophilic greening in the workplace is anticipated to alleviate stress and enhance cognitive function among office employees; nevertheless, prior research mostly focused on college students. Consequently, their findings are not immediately applicable to office employees. Assessing the impact of biophilic design on office workers may provide concrete evidence of enhanced workplace conditions and improved health outcomes.

Objective 2. To assess the effects of biophilic design on emotional health outcomes from existing studies.

It is essential to explicitly delineate the different concepts, beginning with 'biophilia,' which refers to the intrinsic human affinity for nature and living systems. It is predicated on the notion that individuals possess an inherent affinity for life and life-like activities, which may profoundly influence their wellness. The word was popularised by scientist Wilson, who posited that this connection to

nature is fundamentally embedded in human biology and psyche [21].

Figure 2. The Benefits of Biophilia in Mental Health

Source: https://biophilicproducts.org/wp-content/uploads/2025/09/benefits-biophilia.jpg

Biophilia is practically expressed in design and architecture through the integration of natural elements, including natural light, vegetation, and organic forms, to promote human health, alleviate stress, and enhance overall wellbeing. This notion is progressively used across several domains, particularly in healthcare, where biophilic design seeks to create surroundings that enhance healing and comfort for patients and carers. The word 'biophobia' refers to the fear or aversion to natural elements and biological systems. It is the antithesis of biophilia and may present as discomfort or anxiety in natural settings, potentially including aversions to fauna, flora, or natural landscapes. This term encompasses a spectrum of reactions, from little unease to profound anxiety or avoidance behaviours [22].

This idea is significant in numerous settings, such as design and therapy, where comprehending an individual's or group's biophobic inclinations may aid in developing surroundings that alleviate stress and promote comfort. Biophilic design is an architectural and interior design concept that incorporates natural elements into constructed surroundings to improve human wellness and foster a connection with nature. This design philosophy is grounded on the idea of biophilia, which asserts that people possess an intrinsic affinity for nature [23].

Objective 3. To identify key biophilic elements influencing employee satisfaction and engagement.

Employees in open-plan workplaces have been seen to have increased distractions, uncooperative behaviours, adverse relationships, and mistrust. Furthermore, existing data indicates that shared workplaces have diminished the quality of the interior environment, hence adversely affecting employee well-being [24]. Ergonomics has traditionally focused on the impact of indoor environmental quality on employee well-being and performance. Recently, in response to calls for a nature-centric approach, there has been increased emphasis on greening workspaces or biophilic design as a strategy to enhance the well-being of employees in open-plan offices [25].

Biophilic design incorporates nature into work environments to facilitate workers' significant interaction with the natural world. Self-reported employee counts of visible plants or natural features, as well as green window views, exhibit a favourable correlation with productivity, work happiness, and job engagement. Likewise, indoor nature exposure (NE) is associated with employee well-being. Nevertheless, several research indicate little effects, nonsignificant impacts on long-term well-being, and considerable diversity in NE across employees [26].

Table 1. Key Biophilic Elements

Biophilic Element	Description
Natural Lighting	Use of daylight to enhance indoor illumination
Indoor Plants	Presence of greenery within workspace
Views of Nature	Visual access to outdoor natural environments
Natural Materials	Use of wood, stone, bamboo in interiors
Water Features	Inclusion of fountains, aquariums
Ventilation & Air Quality	Natural airflow and improved air circulation
Nature-inspired Colors	Use of earthy tones and organic color palettes

This paper also investigated the role of employees' nature relatedness (NR) as a trait that elucidates the varying responses of employees to NE. NR, defined as "one's subjective sense of connection with the natural world," has been shown to account for the differences in the perceived restorativeness of nature. Individuals with elevated levels of Nature Relatedness see natural surroundings as more appealing and intriguing, assign a higher restorative capacity to these settings, and are more inclined to pursue encounters in nature [27]. In the working environment, NR was only assessed by those who indicated a link between pleasure with biophilic design, NR, and self-reported health.

6. Discussion

The results of the current research are in a significant way confirming the hypothesis that biophilic interior design affects positively cognitive performance in

work places. The review of the secondary data shows that the exposure to natural factors like indoor plants, natural light, and organic materials leads to lower levels of stress and better capacity of attention. This is in line with the applications of the Attention Restoration Theory (ART) and the Stress Restoration Theory (SRT), which describe how the natural environment can be used to restore the cognitive resources and facilitate mental recovery. The noted changes in memory, concentration, and task performance can be discussed as possible to improve the overall productivity and cognitive activity when biophilic aspects are incorporated in the office areas.

Additionally, it is shown in the discussion that just as much, the emotional health benefits of biophilic design are important. The analyzed articles have a consistent finding of decreases in anxiety, fatigue, and depression and an increase in positive moods, including relaxation, vigor, and emotional stability. These results have a theoretical basis in the concept of biophilia, which focuses on the human in-touch with nature. The use of the natural elements such as greenery, daylight, and nature-related patterns helps to produce a soothing and restorative atmosphere, which especially comes in handy in the high-stress working environment. This evidence supports the notion that biophilic design is not simply aesthetic but it is also a significant factor in psychological health.

Moreover, the research determines crucial biophilic factors which have a high impact on employee satisfaction and engagement. Such aspects as the natural illumination, the presence of vegetation in the room, wooden board, and the use of visually pleasing natural analogues proved to increase comfort, decrease mental fatigue, and enhance job satisfaction. The relative comparison between various studies implies that the direct exposure to nature (e.g., to plants and daylight) is more immoderately beneficial, whereas the indirect ones (e.g., to textures and patterns) lead to moderate yet significant mood and perception enhancement. This underscores the significance of the holistic approach of designing that incorporates various biophilic elements, to get the best results within the work set-ups.

Nevertheless, even though the results were positive, some limitations and gaps in research were found. Numerous studies use the controlled setting or even special groups of the population like students, which might constrain an external applicability of the findings to various work environments. Secondly, there is a problem of instability in the design implementation and measures, which makes it difficult to draw uniform conclusions. The next step of the research must take place in the long-term and real-life studies in the workplace and also involve the use of modern technologies like virtual reality and biometric surveillance to help in more accurate determination. Comprehensively, it can be concluded that biophilic interior design is a prospective and sustainable approach to the improvement of cognitive, emotional, and employee health in contemporary workplaces.

7. Conclusion

This study shows that biophilic interior design improves workplace cognition and mood. According to secondary data analysis of several studies, natural elements like greenery, natural light, ventilation, and natural materials improve attention, memory, and mental performance. The findings support Attention Restoration Theory (ART) and Stress Reduction Theory (SRT) since exposure to nature reduces cognitive tiredness and improves focus. Thus, biophilic design creates a more productive, entertaining, and challenging work environment.

Moreover, this research illustrates that biophilic design is rather influential in terms of emotional health outcomes. Workers in settings that are rich with natural factors are likely to have lower levels of stress, anxiety, and fatigue as well as elevated levels of comfort, relaxation, and positivity. The psychological relaxation and the emotional stability are provided through the introduction of nature-like elements, i.e., the natural textures, the views of the nature, and the greenery. Not only do these things add to individual well-being, they also lead to a healthier organizational climate. Thus, biophilic interventions might be discussed as an efficient solution in order to mental health promotion in contemporary workplace.

Moreover, the study also reveals the most significant biophilic factors that have a strong influence on the satisfaction and engagement of employees. Such features (as natural light, indoor vegetation, wooden materials, and nature-based designs) are always positively related with the morale of employees and satisfaction with the workplace. These aspects make the surrounding more interesting and pleasing in which the creativity, motivation, and productivity are promoted. Nevertheless, it is also stated in the study that the performance of these factors may differ, basing on the workspace and cultural environment, which means that unique design strategies should be developed according to the particular organizational environment.

In summary, the incorporation of principles of biophilic design in workplaces is highly beneficial in cognitive, emotional, and engagement terms. Although the research gives very good evidence to support such results, it also indicates that more empirical studies are needed, especially in the context of real-life offices and diverse populations.

Further research on how to measure the long-term effects and immediate research on cutting-edge technologies like virtual reality and biomonitoring would be valuable in future research. On the whole, the biophilic design is not a mere trend in design but an essential element of human-centred design that facilitates better, healthier, and more sustainable working conditions.

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